

EC-8 SOIL BINDERS

Refer to: ITD Standards and Specifications for Highway Construction, Section 212.
QPL Category: 212 Soil Binder



BMP Objectives

- | | |
|-------------------------------------|-----------------------|
| <input type="checkbox"/> | Perimeter Control |
| <input checked="" type="checkbox"/> | Slope Protection |
| <input checked="" type="checkbox"/> | Borrow and Stockpiles |
| <input checked="" type="checkbox"/> | Drainage Areas |
| <input type="checkbox"/> | Sediment Trapping |
| <input type="checkbox"/> | Stream Protection |
| <input checked="" type="checkbox"/> | Temporary Stabilizing |
| <input checked="" type="checkbox"/> | Permanent Stabilizing |

Definition and Purpose

Soil stabilizers are applied to exposed or disturbed soil to reduce wind and water erosion, typically as a final treatment when construction activity has ceased.

Dust palliatives are used during construction to reduce dust emissions due to mechanical and wind forces, and typically do not have the longevity of soil stabilizers.

Appropriate Applications

Soil stabilizers are applied where specified in the contract plans or as directed by the engineer. Dust palliatives are typically applied at the Contractor's discretion to disturbed areas requiring short-term temporary protection for erosion control/dust control and to comply with air quality standards. Because dust palliatives can often be incorporated into the work, they may be a good choice for areas where grading activities will soon resume. They can be applied on stockpiles to reduce water and wind erosion.

Limitations

- Soil stabilizers and dust palliatives are temporary in nature and may need reapplication.
- Soil stabilizers and dust palliatives require a minimum curing time until fully effective, as prescribed by the manufacturer, which may be 24 hours or longer.
- Soil stabilizers and dust palliatives may need reapplication after a storm event and will generally experience spot failures during heavy rainfall. If runoff penetrates the soil at the top of a treated slope, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.
- Some soil stabilizers and dust palliatives do not hold up to pedestrian or vehicular traffic across treated areas. For traffic areas, be sure to select an appropriate product.

- Soil stabilizers and dust palliatives may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.
- Some soil stabilizers and dust palliatives may have a deleterious effect on long-term landscaping.
- Some soil stabilizers and dust palliatives may not perform well with low relative humidity. Refer to manufacturers' literature for humidity limitations. Under rainy conditions, some agents may become slippery or leach out of the soil.
- May not cure if low temperatures occur within 24 hours of application. Refer to manufacturers' literature for temperature limitations.

General Considerations

- Site-specific soil types will dictate appropriate soil stabilizers or dust palliatives to be used.
- Soil stabilizers and dust palliatives must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and shall not stain paved or painted surfaces.
- Some products are compatible with existing vegetation.
- Performance of soil stabilizers and dust palliatives depends on temperature, humidity, and traffic across treated areas.
- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.

Selecting a Soil Stabilizer or Dust Palliative

Properties of common soil stabilizers and dust palliatives used for erosion control are provided in Tables 1 and 2. Use Table 1 to select a product for non-traffic applications, and Table 2 for traffic areas. Refer to EC-14 (Wind Erosion Control) for more information about dust control. Factors to consider when selecting a product include the following:

- Suitability to situation: Consider where the product will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time stabilization will be needed, and if the product will be placed in an area where it will degrade rapidly.
- Soil types and surface materials: Fines and moisture content are key properties of surface materials. Consider a soil stabilizer or dust palliative's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials. Soil information can be obtained from the project's geotechnical report or from a Natural Resources Conservation District (NRCS) website.
- Frequency of application: The frequency of application can be affected by subgrade conditions, surface type, climate, and maintenance schedule. Frequent applications could lead to high costs. Application frequency may be minimized if the dust palliative has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean-up.

Qualified Products List Criteria

Shall have a manufacturers' certification that it is nontoxic to plant or animal life and nonstaining to concrete or painted surfaces.

Plant-Material Based (Short-Lived)

Short-lived products may only be used as dust palliatives.

Guar: Guar is a non-toxic, biodegradable, natural galactomannan-based hydrocolloid treated with dispersing agents for easy field mixing. Typical recommended minimum application rates are as follows:

Typical Application Rates for Guar Soil Stabilizer

Slope (V:H):	Flat	1:4	1:3	1:2	1:1
lb/acre:	40	45	50	60	70
kg/ha:	45	50	56	67	78

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Typical application rates are 80 to 200 pounds/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold-water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water. The typical application rate is 150 pounds/acre. Approximate drying time is 9 to 12 hours.

Plant-Material Based (Long-Lived)

Tall Oil Pitch/Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48 percent. The rosin shall be a minimum of 26 percent of the total solids content when included. The addition of rosin will strengthen the stabilizer, but also makes it more brittle and less UV resistant, decreasing its effective duration. The soil stabilizer shall be a non-corrosive, water-dilutable emulsion that upon application cures to a water-insoluble binding and cementing agent. Typical application rates will be per the manufacturer's recommendations for the given situation and required duration.

Lignin Sulfonate: Byproduct of the kraft paper-making process, it is a natural adhesive that holds plant fibers together. It greatly increases the dry strength of the soil, is not humidity-dependent, lowers the freezing point of the road, and retains its effectiveness after reblading. High solubility results in leaching during heavy precipitation. Lignin products have a high biochemical oxygen demand and should not be used where runoff could contaminate a body of water. A neutralizing additive must be added to reduce its corrosive effects to aluminum alloys.

Application can be by water truck or hydraulic seeder with the emulsion/product mixture application rate as specified by the manufacturer.

Polymeric Emulsion Blends

Acrylic Copolymers and Polymers: Polymeric soil stabilizers shall consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55 percent solids. The

polymeric compound shall be handled and mixed in a manner that will not cause foaming or shall contain an anti-foaming agent. The polymeric emulsion shall not exceed its shelf life or expiration date, which will be provided by the manufacturers. Polymeric soil stabilizer shall be readily miscible in water, non-injurious to seed or animal life, non-flammable, shall provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and shall not re-emulsify when cured. The applied compound shall air-cure within a maximum of 36 to 48 hours. Liquid copolymer is typically diluted at a rate of 10 parts water to 1 part polymer and applied to soil at a typical rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100 percent acrylic emulsion blend of 40 percent solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water and typically applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and typically applied to the soil surface for erosion control at rates that are determined by slope gradient.

Slope Gradient (H:V)	lb/acre	kg/ha
Flat to 5:1	3.0 – 5.0	3.4 – 5.6
5:1 to 3:1	5.0 – 10.0	5.6 – 11.2
2:1 to 1:1	10.0 – 20.0	11.2 – 22.4

Poly-Acrylamide and Copolymer of Acrylamide (PAM): Linear copolymer polyacrylamide is packaged as a dry-flowable solid. PAM is used as a tie-down for soil, compost, or seed, and is also used as a flocculent. When used as a stand-alone stabilizer, it is typically diluted at a rate of 10 pounds/1,000 gallon of water and applied at a typical rate of 5.0 pounds/acre.

- The specific PAM copolymer formulation shall be anionic. Cationic PAM should not be used in any application because of known aquatic toxicity problems.
- Shall meet ANSI/NSF Standard 60 for drinking water treatment with an acrylamide (AMD) content not to exceed 0.05 percent.
- PAM designated for erosion and sediment control shall be “water soluble” or “linear” or “non-cross linked.”
- The minimum average molecular weight shall be greater than 5 mg/mole and minimum 30 percent charge density.
- Shall contain at least 80 percent active ingredients and have a moisture content not exceeding 10 percent by weight.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry-flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at typical rates of 50 to 60 pounds/acre. Drying times are 0 to 4 hours.

Cementitious-Based

Gypsum: This is a formulated gypsum-based product that readily mixes with water and sometimes mulch to form a thin protective crust on the soil surface. It is composed of high-purity gypsum that is ground, calcined, and processed into calcium sulfate hemihydrate with a minimum purity of 86 percent. It is mixed in a hydraulic seeder and applied at typical rates of 4,000 to 12,000 pounds/acre. Drying time is 4 to 8 hours.

Petroleum-Based

Petroleum Resin Emulsion: These products coat soil particles, increasing their mass and decreasing their likelihood of becoming airborne, but do not exhibit adhesive properties. They are water-insoluble once cured, and hence provide a degree of surface waterproofing and have good residual effectiveness. Used oils are prohibited as a soil stabilizers or dust palliatives, because they contain toxic substances. Petroleum resin products should only be used for traffic areas such as haul roads, parking, and staging areas.

Applying Soil Stabilizers and Dust Palliatives

After selecting an appropriate product, the untreated soil surface must be prepared before applying the soil stabilizer. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps shall be followed:

- Follow manufacturer's recommendations for application rates and pre-wetting of application area.
- Prior to application, roughen embankment and fill areas. Track walking shall only be used where rolling is impractical.
- Consider the drying time for the selected product and apply with sufficient time before anticipated rainfall. Generally, soil stabilizers and dust palliatives require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure times. Soil stabilizers and dust palliatives shall not be applied during or immediately before rainfall.
- Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.
- Soil stabilizers and dust palliatives shall not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the air temperature is below 4°C (40°F) during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate. Follow the manufacturer's application instructions.
- For liquid agents:
 - Crown or slope ground to avoid ponding.
 - Uniformly pre-wet ground at 0.03 to 0.3 gallon/square yard or according to manufacturer's recommendations.
 - Apply solution under pressure. Overlap solution 6 to 12 inches.

- Allow treated area to cure for the time recommended by the manufacturer; typically, at least 24 hours.
- In areas with low humidity, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gallon per square yard.

Maintenance and Inspections

- Conduct inspections as required by the NPDES permit or contract specifications.
- Reapply the selected soil stabilizer for proper maintenance, as needed.
- After any rainfall event, maintain all slopes to prevent erosion.
- Maintain any unbroken, temporary mulched ground cover while disturbed soil areas are non-active. Repair any damaged ground cover and re-mulch exposed areas.
- Follow manufacturer's recommendations for maintaining and cleaning equipment after use.
- Maintenance and repair applications shall be included in the bid price.

Table 1
Properties of Soil Stabilizers for Erosion Control (Non-Traffic Areas)

Chemicals	Plant Material Based (Short Lived)	Plant Material Based (Long Lived)	Polymeric Emulsion Blends	Cementitious-Based Stabilizers
Relative Cost	Low	Low	Low	Low
Resistance to Leaching	High	High	Low to Moderate	Moderate
Resistance to Abrasion	Moderate	Low	Moderate to High	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	9 to 18 hours	19 to 24 hours	0 to 24 hours	4 to 8 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Biodegradable	Biodegradable	Photodegradable/Che mically Degradable	Photodegradable/ Chemically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Liquid/Powder	Powder	Liquid	Liquid/Powder	Powder
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes, but dissolves on rewetting	Yes
Clean-Up	Water	Water	Water	Water
Erosion Control Application Rate	Varies	Varies	Varies	4,500 to 13,500 L/Ha

Table 2
Properties of Soil Stabilizers for Erosion Control (Traffic Areas)

Chemicals	Ligninosulfonate	Tall Oil Pitch Emulsion	Petroleum Resin Emulsion
Relative Cost	Moderate	Moderate	Moderate
Resistance to Leaching	Low	High	High
Longevity	Medium	Medium to Long	Medium
Minimum Curing Time before Rain	24 hours +	30-60 min (Prime Coat) 8-24 Hours (Mixed Into Base)	0-4 hours
Mode of Degradation	Biodegradable	Biodegradable	Photo/Chemically Degradable
Labor Intensive	No	No	No
Specialized Application Equipment	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher	Water Truck or Hydraulic Mulcher
Surface Crusting	Yes, but dissolves on rewetting	Yes	Yes
Clean-Up	Water	Water, before it dries	Water, before it cures